time, or with the consumption of less fuel than any other carbonate of lime. When burnt, the colouring matter has entirely departed, leaving a snow-white and perfectly caustic lime, of an open and friable structure, more so than that produced by any other compact limestone, and which falls down into an almost impalpable powder, either with slaking, or if left exposed to the air. These remarks apply generally to the bituminous limestones, which may be considered as identical, but for the fetid smell above referred to. These stones are of a dark hue, varying from brown to a duskiness almost black.

15. Magnesian limestone is, in its structure, a concretion of small crystals, having the appearance of fine sandstone, and consisting of about two-fifth parts magnesia and three-fifth parts lime: its usual colour is a pale yellowish brown, occasionally approaching red.

16. Basaltic rocks are found by chemists to contain the same components as the best hydraulic cements; it is therefore reasonably supposed that they would, on calcination, afford cements of very good quality. The Giant's Causeway, on the coast of Antrim, in Ireland, is the most famous: the Calton-hill of Edinburgh is almost an entire mass of it. The celebrated Tarras stone of Germany, so much used by the Dutch in their great water-dykes, is a species of cellular basalt.

17. Stone limes of almost any kind are durable and excellent, if properly burnt and used immediately; or, failing the latter, kept very close. Those should be selected which slake most readily, accompanied with the greatest heat; also which dissolve in distilled vinegar with the slightest effervescence, and leaving behind the least residue of insoluble matter. Many stone limes, however, are apt to stain the masonry with which they are brought into contact, rendering them somewhat unsuitable for superior ashlar-work, if the first cleanness of the work weigh much with the architect.

18. Although chalk lime is unquestionably inferior to that produced from limestone, there are, nevertheless, vast quantities of it made, and it is extensively employed even where the other is not difficult to obtain. In the south-eastern parts of the kingdom it is the principal kind in use; and in London large quantities of it are consumed in every possible description of building, and by the most eminent architects and engineers. Unfortunately it is seldom sufficiently burnt, which indeed is said to be a general fault with the lime-trade in this country; probably owing to the high cost of fuel in some parts; and from this circumstance it often presents the disadvantage of containing, after slaking, small unburnt, or superficially-burnt lumps, or "cores," which are, without difficulty, pounded down with the spade in making mortar, although they ought to be scrupulously excluded, being manifestly quite unsuitable and injurious. The common white chalk is composed of very pure calcareous matter; therefore, though furnishing a good white lime very suitable for ordinary building as well as for interior finishings, not at all adapted for water-cement. It is soft, porous, and easily quarried; it contains about 53 per cent. of lime, 2 of alumina, 42 of acid, and 3 of water. The Sussex Clunch-lime obtained in the neighbourhood of Lewes, the Berryton grey lime procured near Petersfield in Hampshire, the grey lime of Guildford, Dorking and Merstham in Surrey, of Purfleet, and of Halling in Kent, the extensive quarries of which supply the London market, are all of chalks, but distinguished from the preceding by their dark shade, and by their possessing the essential properties of water-cements; they are harder than the common chalk: their proportion of clay varies from about 5 to 25 per cent; in the Dorking lime it is ascertained to be about $\frac{1}{10}$th of the whole; and the others of that district differ very little from it: they are all, after burning, of a pale brownish-yellow colour.

19. Shell lime, which is said to be the most extensively used in America for architectural purposes, is in England scarcely known. This may be owing in a measure to the circumstance of shells requiring to be more highly calcined than common limestone, and which probably is in consequence of their being purer carbonate of lime; but the chief reason of its being so little known among us, no doubt, is the abundance in which limestone and chalk are found. It has been ascertained that the lime of cockles, &c. is the worst of all for hydraulic cements, for although it has the property of rapidly hardening it, soon decomposes under water; yet, it is said, a good cement may be produced by tempering, with water, powdered oyster-shells and about $\frac{1}{4}$th of clay, forming the mixture into small lumps, letting these dry in the air, and then burning them for about 96 hours. The lime of oyster-shells is also said to endure fire well, and has been suggested as suitable for such purposes as the setting of furnaces, ovens, &c.

20. The substance of the CORAL islands and reefs, is lime, but whether experiments have been made on that product, inquiring its adaptation to building-purposes, or whether it has actually been made available in that way the writer is at present unaware.

(To be continued in our next.)

PETRALOGY, OR THE KNOWLEDGE OF ROCKS AND STONES.

BY HENRY C. MONTAGUE, ESQ., PROFESSOR OF NATURAL PHILOSOPHY.

UPON the surface of the earth, in the valleys, upon the mountains, plains, in the air, and in the waters, man finds abundant evidence of a beginning of things, of a time or times when the phenomena before him were not: he beholds that beginning in generation, regeneration, decay, and death; in the gradual development of capacities and powers, quantities and qualities; in the simple and complex structure of the organic body; and in the characteristic marks noted in each succeeding stratum. In and throughout the earth there is not a rock, stone, or mineral aggregate, which does not attest the gradual and progressive development of general orders, and species, the consequent gradual development of these earths, fossils, and species. United or disintegrated, as calcareous matter, clay, vegetable earth—or beds of mixed qualities, as rocks, stones, or minerals—we behold the same material varying in its unions, but definite in its nature, or the subject of change produced by local or general influence. In the living fountain, we see the earths generate; in the fossil kingdom, we see the earths thus elaborated, preserved in the characteristic form of the animal or vegetable; in the mineral kingdom, we behold the vegetable body, and acknowledge it in change and decomposition.

To have a correct understanding of natural phenomena, is a means whereby we are enabled to render nature more immediately subservient to our wants and purposes, and to apply its varied products to practical purposes. It is not sufficient that we become acquainted with the names, and are therefore enabled to classify rocks; it is not sufficient that we know what they are resolvable into by the tortuous means of fire, their expanding, contracting, or absorbing powers, their weight, and density: we must go still further, we must study the laws of Nature and her *modus operandi*, physical condition, and the changes likely to be undergone by materials when used for architectural purposes. It is from a want of this knowledge that men unite, in buildings proposed to immortalize themselves, the elements of destruction; from generalizing, without the appliances of sterling science, architects fall into the common error of using materials containing within themselves the elements of dissolution, or dispose them in places equally inimical to their continuance. Why do buildings so soon fall into decay in this country? Why but from the use of ill-made cements and the use of ill-chosen materials, the want of knowledge of locality in which such buildings are disposed, and of the bed on which they rest?

The difficulty of mastering the technical phrases of geology, of attaining a knowledge of its fundamental principles, and still more of reconciling its endless contradictions and palpable absurdities, has determined many practical men against the study of this science. It is indeed to be lamented that the many crude and ridiculous speculations of modern geologists should render this fair and beautiful field of Nature unapproachable by common observation, and inutile to the practical appliances of life. The operations of Nature are simple, whether we consider them in life, or consequent of living action: the laws which regulate change, and by which the varied phenomena of the earth are produced, being brought into existence, still continue to exist in place and disposition; and it is not because the closet speculator cannot see them in operation, that we are bound to discredit their existence in the present day. Rocks, stones, minerals, and earths are still forming in every region of the earth, not at all times palpably manifest to observation, but still, ever demonstrable from existing causes; and the having correct ideas of the nature, origin, and properties of these bodies, brings with it a knowledge of the conditions under which they continue to exist, and the purposes to which they ought to be applied.

The substances of which the earth's strata are principally composed are siliceous, calcareous, bituminous, and argillaceous earths. Of these, silica is the most abundant, and the first or primary material of this earth, composing in entirety the lowest beds, as pure sands or sandstone, in which all traces of organic species are entirely obliterated, and forming the exclusive or mixed material of every stratum disposed on or near its surface. Upon this general, nay, universal, siliceous base, we find the calcareous masses and limestones locally disposed; the several varieties being distinguished by their uniformity of character and composition, by the nature of their earths, and by their organic remains. The third story of this beautiful fabric is composed of argillaceous and bituminous beds, homogeneous, or of mixed qualities, crowning the preceding beds, or variably blended with them; the crowning deposits forming *terra firma*, and all the singular and varied phenomena produced under atmospheric influences. The silica generated within the waters is the primary material in the sequence of events; but inasmuch as this particular earth is still producing, both within the waters and upon the earth, so it must be borne in mind that, besides being primary, it is secondary, recent, and still producing; in like manner with calx rocks and calcareous bodies and beds, calx is a secondary and still existing effect of the continuance of existing causes. The same remarks apply to bituminous, argillaceous, and other rocks.

Petralogy, or the knowledge of rocks and stones which occur in large masses, embraces in the order of their development, according to my system, as derived from observation of natural phenomena,—

1. Siliceous rocks.
2. Calx rocks.
3. Carboniferous rocks.
4. Magnesian rocks.
5. Argillaceous rocks.
6. Composite, or aggregated rocks.
7. Siderous rocks, or those in which iron predominates.
8. Diamotonic rocks, in which the substances are equally blended.
9. Anomalous rocks, presenting unusual combinations and singularities.
10. Transition rocks.
11. Decomposed rocks.
12. Volcanic rocks.

Under these several heads are embraced the endless varieties produced by the accidental union of one with another.

Professor Brande, in his first of ten lectures on agricultural chemistry, delivered in January last at the Royal Institution, gravely informs the student, that originally the surface of the earth was composed of hard rocks which by the influence of moisture, or other agents, have gradually become disintegrated, and fitted to the growth of plants. This singular theory, which at once places the origin of rocks beyond the discovery of man, is not only inconsistent with observation and the rules of analysis, but actually reverses the natural order of events. Rocks are compound bodies, simple in their mixtures, as quartz, limestone, and slate; and compound when two or more minerals enter into their composition, as gneis, granite, sienite, porphyry, &c.: they are results of agglutination, being held together by one or more mineral bodies, which form their common bases or cement; silica and alumina, together or separate, being the cementing bases of most of the rocks of the earth. They are sometimes formed from the decomposed rocks and soils of ancient lands, but primarily they are formed and are still forming by the agglutination of parts of calcareous, siliceous, and aluminous beds; the nature of the earths determining the composition and material of these rocks, and the peculiar structure they assume